

November 13, 2002

MEMORANDUM TO: Theodore R. Quay, Chief
Equipment and Human Performance Branch
Division of Inspection Program Management
Office of Nuclear Reactor Regulation
/RA/

FROM: David C. Trimble, Chief
Operator Licensing and Human Performance Section
Equipment and Human Performance Branch
Division of Inspection Program Management
Office of Nuclear Reactor Regulation

SUBJECT: SUMMARY OF THE OCTOBER 3, 2002, PUBLIC MEETING TO
DISCUSS THE DEVELOPMENT OF A PROPOSED WORKER FATIGUE
RULE

On October 3, 2002, the staff held the sixth in a series of public meetings regarding the development of a proposed rule concerning worker fatigue at nuclear power plants. The rulemaking has been proposed as an amendment to 10 CFR 26, "Fitness for Duty Programs." The meeting participants (see Attachment 1) included representatives from the Electric Power Research Institute (EPRI), The Institute for Nuclear Power Plant Operations (INPO), the Nuclear Energy Institute (NEI), the International Brotherhood of Electrical Workers (IBEW), individual utilities, and members of the public. The meeting agenda is provided as Attachment 2.

The meeting began with a discussion of several items from past stakeholder meetings concerning scope of personnel subject to the proposed work scheduling controls. The staff provided several draft white papers describing the scope of personnel performing fire brigade, maintenance, and chemistry functions that the staff proposes to be subject to the work scheduling controls (see attachments 3-5). The staff proposed that the three members of the fire brigade required to have knowledge equivalent to a licensed operator be subject to the work scheduling controls. Industry stakeholders proposed that the work scheduling controls for the fire brigade function be limited to individuals functioning as the fire brigade leader. The staff agreed to evaluate the industry proposal. The staff also noted that the Union of Concerned Scientists (UCS) had submitted a letter proposing that individuals performing fire watches should be subject to the work scheduling controls. Industry stakeholders were opposed to the inclusion of personnel performing fire watches and agreed to provide a written basis for their position. The matter was left as an open item for discussion at a meeting that included representation by UCS. The staff proposed that the scope of maintenance personnel subject to the work schedule controls be limited to those individuals working on or directing work on equipment monitored in accordance with 10 CFR50.65(a)(4). Industry stakeholders proposed limiting the scope to personnel performing these activities associated with High Safety

Significance Components. NEI agreed to reconsider the staff proposal with the objective of identifying a scope that was risk-informed and sufficiently stable to allow practical control of work schedules. The staff proposed that on-shift chemistry technicians assigned emergency response functions should be subject to the work scheduling controls. There was general agreement among meeting participants with this proposal.

Regarding work scheduling controls, the staff proposed development of graded work scheduling controls for extended outages and defining limits on the exclusion of turnover time from work scheduling controls. Industry stakeholders stated that their review of overtime use in past extended outages suggested that overtime was not high for the duration of these outages suggesting longer term limits may not be necessary. The matter of limits for extended outages was left as an open item. Regarding turnover time, industry stakeholders proposed that limitations on the exclusion of turnover from work scheduling controls should focus on the scope of activities rather than the amount of time. The stated advantage of focusing on scope of activities rather than time was reducing the potential of an implied time limit on turnovers that could compromise the effectiveness of the turnover. The staff acknowledged the merit of the proposed approach and NEI agreed to develop a definition of turnover that would limit the activities that could be excluded from work schedule controls as turnover time. Preliminary concepts discussed at the meeting for the turnover definition would limit turnover to activities necessary to safely hand-off responsibilities to another worker but would exclude intra-shift turnovers, special evolution briefings, and hold-overs for late arrival of relief personnel.

The primary focus of the meeting was to discuss the process for authorizing deviations from the work schedule thresholds and for monitoring the effectiveness of alertness management programs. The staff proposed (see Attachment 6) that the acceptable bases be limited to situations in which the worker is determined to be fit for duty and (1) the scope of the work and responsibilities will not require functions subject to work scheduling controls, or (2) working in excess of the threshold is necessary to: (a) comply with other NRC regulations, or (b) avoid a forced shutdown, or (c) maintain or enhance immediate capability for responding to challenges to plant safety. Industry stakeholders stated that they did not believe a workable set of criteria could be established and expressed concern that the staff's proposed criteria did not allow for exceeding the threshold for economic reasons if such activities did not compromise safety. The staff agreed to consider developing a basis that would not preclude economically advantageous, safety neutral circumstances. Regarding the timing of authorizations, there was general agreement with the staff proposal that authorizations must be performed prior to exceeding a threshold and that the assessment of worker fitness-for-duty (FFD) should be performed immediately before a worker exceeds a threshold. The staff proposed that the FFD assessment should be performed by the worker's immediate supervisor but the authority to approve deviations should be limited to individuals qualified to assess the risk significance of the scope of the work to be performed during the threshold deviation. Industry stakeholders were in general agreement with these proposals

Regarding monitoring of program effectiveness, the staff identified more than a half dozen sources of data that could be used for monitoring purposes (see Attachment 6). Industry stakeholders were generally of the opinion that other than monitoring compliance with program procedures or the results of root cause investigations, it was not possible to monitor program effectiveness. The staff expressed the opinion that compliance with program procedures may not be a reliable measure of effectiveness and that in order for root cause assessment results to be considered a credible basis for effectiveness monitoring it would be necessary to establish

minimum standards for the analysis of worker fatigue in root cause assessments. NEI agreed to evaluate the need for such guidance in their development of implementation guidance for the proposed rule.

The staff closed the meeting with a commitment to schedule the next meeting during mid-November or early December and to conduct interim public teleconferences for discussion of open items from this meeting.

Attachments: As stated

Mr. T. R. Quay

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Public Meeting to Discuss Development of a Proposed Rule Concerning
Worker Fatigue at Nuclear Power Plants

October 3, 2002

Attendance List

NAME	AFFILIATION
Ted Quay	NRC
Getachew Tesfaye	Constellation Generation Group
Ralph Mullis	Progress Energy
Clare Goodman	NRC
Jenny Weil	McGraw-Hill
Bob Evans	NEI
Mark Burzynski	TVA
Bryan Dolan	Duke Energy
James Davis	NEI
David Ziebell	EPRI
David Shafer	Amergen UE
Martin Humphrey	FENOC
Clair Goddard	INPO
Will Paul	IBEW
Mark Burzynski	TVA
David Desaulniers	NRC
Michael Sontag	APS / Palo Verde - STARS
Phil Qualls	NRC
Patrick Shaffer	SCE / San Onofre Nuclear Gen. Station
Susan Yim	Ballard, Spahr, Andrews, & Ingersoll, LLP
Marjorie Rothschild	NRC
Brian Richter	NRC
Tammy Croote	NRC
Eric Weiss	NRC
NAME	AFFILIATION

Steve Alexander	NRC
J. Persensky	NRC
David Trimble	NRC
Wayne Scott	NRC
Robert Moody	NRC
Dave Goldin	SC&A

MEETING WITH STAKEHOLDERS TO DISCUSS DEVELOPMENT OF A
PROPOSED RULE CONCERNING WORKER FATIGUE
AT NUCLEAR POWER PLANTS

October 3, 2002

AGENDA

- 8:30-8:45 Introductions and Opening Remarks
- 8:45-9:00 Basis of Personnel Scope Requirements
- 9:00-9:45 Personnel Scope - Open Items
Fire Brigade
Fire Watch
Application of 10 CFR50.65(a)(4) scope to maintenance functions
- 9:45-10:15 Work Scheduling Controls - Open Items
Turnover
Outage duration
- 10:15-10:30 Break
- 10:30-12:00 Authorization of deviations from work scheduling controls
Criteria
Timing
Authority
- 12:00-1:00 Lunch
- 1:00- 2:30 Performance Monitoring
- 2:30-2:45 Break
- 2:45-3:30 Record Keeping
- 3:30-4:30 Regulatory Analysis
- 4:30-5:00 Meeting Summary and Future Schedule

Note: This is a Category 3 Meeting. The public is invited to participate in this meeting by providing comments and asking questions throughout the meeting.

DRAFT

WHITE PAPER DISCUSSING INCLUSION OF CERTAIN FIRE BRIGADE MEMBERS IN PROPOSED WORK SCHEDULING CONTROLS

PROPOSAL

Three members of the fire brigade are required (basis listed below) to be able to advise the control room operators and fire brigade leader of the effects of the fire and fire suppressants on safe shutdown capability. The staff proposes that those individuals be subject to the proposed work scheduling requirements.

BASIS

- Attachment 1 to SECY-99-140, Recommendation for Reactor Fire Protection Inspections (WITS Item 199700021), dated May 20, 1999, is a Fire Risk Fact Sheet. Stated here is that “Based on IPEEE results, fire events are important contributors to the reported core damage frequency (CDF) for a majority of plants. The reported CDF contribution from fire events can, in some cases, approach (or even exceed) that from internal events.
- The fire brigade is a regulatory requirement necessary to meet 10 CFR 50.48a. 10 CFR 50.48a requires all operating NPPs to have a fire protection program that meets GDC III. 10 CFR 50.48b defines this program as 10 CFR 50, Appendix R in its entirety. Most licensees do not have to meet the verbatim section of Appendix R on fire brigade because an earlier licensing requirement to comply with BTP 9.5-1 (same requirements) was incorporated into a facility operating license.
- Fire brigade members must retain the cognitive ability to be able to make decisions concerning smoke ventilation to prevent the fire effects from affecting other plant operations, they must be able to think and determine the best way to suppress a fire to prevent additional damage to safety related equipment, they must be able to evaluate equipment affected by a fire to report to control room operators concerning equipment availability, and they must be able to coordinate all activities with control room operators. Physical stress may affect cognitive abilities.
 - Physical exertion can affect the fire brigade member cognitive ability. Fire brigade turnout gear consists of a heavy outer coat, heavy gloves, heavy boots, helmet and often an SCBA. In addition, fire brigade members must carry a variety of heavy equipment.
 - As described in Information Notice 2002-27, several recent fires have exceeded one hour in time. At one event two fire brigade members had to be treated for heat exhaustion.
- The Fire Brigade is identified in Table B-1 of NUREG-0654 as part of the minimum staffing for responding to nuclear power plant emergencies. The Fire Brigade may be comprised of personnel from operations, radiological protection, maintenance and security. Many of these personnel are also trained to perform other emergency response functions early on in an event prior to augmentation by other plant personnel. This combination of

responsibilities makes it even more important that these personnel have adequate opportunity for rest and are not unduly fatigued from excessive work hours.

CONCLUSION

Nuclear plant fires can be a significant contributor to plant risk. Fire brigades are required by NRC regulations. Three members of the fire brigade are required to understand the effects of fire and fire suppressants on safe shutdown capability. Normal licensee work activities, applicable to most fire brigade members, will mean that some degree of fatigue exists at the initiation of a fire emergency. To ensure that these three members are able to have the cognitive ability to make the critical decisions necessary during and after the fire, these members should be subject to work schedule control.

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WORK HOURS CONTROL for MAINTENANCE PERSONNEL under 10 CFR PART 26

It has been well established that the performance (particularly in terms of reliability and availability) and condition of structures systems and components (SSCs) that are safety-related, that are used in mitigating accidents or transients, that are used in the emergency operating procedures (EOPs), whose failure could impact a safety function, or whose failure could cause an unwanted scram or engineered safety feature (ESF) activation, depend heavily on the effectiveness of their maintenance. Accordingly, 10 CFR 50.65, the Maintenance Rule (MR), requires monitoring the effectiveness of maintenance or demonstrating that the performance or condition of those SSCs is being effectively controlled through appropriate preventive maintenance. Paragraph (a)(4) of 10 CFR 50.65 also requires assessing and managing the risk associated with maintenance activities involving those SSCs that a risk-informed evaluation process has determined to be significant to the public health and safety.

It has also been well established that plant risk depends in large part on the reliability and availability of risk-significant SSCs as well as on prompt and correct actions by operators in an emergency. The baseline core damage frequency (CDF) as determined by probabilistic risk analyses (PRAs) even includes/assumes a certain amount of unavailability due to planned maintenance and the validity of reliability factors (failure rates) assumed in the fault-tree analyses of the PRAs. These failure rates are based nominally on industry operating experience and depend heavily on maintenance effectiveness that is reasonably consistent with industry norms. While overall maintenance effectiveness is improved over time by monitoring, trending and making improvements where required, the real-time reliability of safety/risk-significant SSCs depends to a great extent on the quality of the maintenance being performed at any given time.

In order to ensure adequate quality of maintenance, in addition to having the requisite training, experience and equipment, it is necessary for maintenance personnel to be fit for duty when actually performing their duties on important SSCs in terms of not being overly fatigued such that their senses and cognitive abilities are impaired. Thus, all other things being equal, maintenance personnel can be expected to do the best work of which they are capable when they are rested and can stay fully focused on the task at hand.

Therefore, in order to effectively manage the adverse effects of fatigue on maintenance to the extent practicable, it is recommended that the work hours of all maintenance personnel who are qualified and capable of working on SSCs that a risk-informed evaluation process has determined to be significant to the public health and safety (i.e., those SSCs that the licensee may have pre-designated for inclusion within the scope of maintenance risk assessments (and management) pursuant to 10 CFR 50.65(a)(4)), who could be called upon to perform either routine maintenance or emergent work on those SSCs, should be controlled in accordance with the work hours control provisions of 10 CFR Part 26.

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CHEMISTRY TECHNICIAN(S) SUPPORT FOR EMERGENCY ACTIONS

On-shift Chemistry Technician(s) provide an important component for a successful response at the onset of a radiological emergency. The independent and timely actions of the Chemistry Technician(s) in response to such an event, can provide key information for assessing core status and estimating the source term of a potential release. By providing defense-in-depth support for operations personnel, Chemistry Technician(s) can also assist with off-site dose calculations and ancillary radiological protection tasks, such as sampling spaces for toxic gases or explosive mixtures. It is therefore important that Chemistry Technician(s) be subject to work schedule control.

Chemical analysis support by Chemistry Technician(s), to take and analyze samples from reactor coolant, ventilation and containment systems, needs to be available on shift. Analyses by Chemistry Technician(s) may be used as the basis for actions to be taken for chemical addition, calculating radio-nuclide concentrations in the reactor coolant, and estimating core damage. Chemical analyses may also be needed for the detection of hydrogen and oxygen gas concentrations in both the reactor coolant and the containment atmosphere, to support severe accident management decisions with regard to minimizing radiological release potential.

In some cases, Chemistry Technician(s) may be assigned to perform off-site dose assessment tasks. Chemistry Technician(s) may also be cross-trained to provide ancillary radiation protection tasks, thereby freeing Health Physics Technicians to cover vital response activities. NUREG-0654 also identifies the need for an on-shift chemistry/radio-chemistry capability.

In summary, Chemistry Technician(s), who are assigned emergency response tasks and may need to work independently, must be rested in order to perform effectively important tasks related to assessing plant status and potential off-site radiological consequences. Therefore, on-shift Chemistry Technician(s) assigned emergency response functions should be subject to work schedule controls.

10/02/2002
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Scope of Functions Subject to Work Scheduling Controls

Licensed and Non-licensed Operations Personnel

Objective: ensure that fatigue does not degrade the ability of operators to maintain the plant in a safe condition

Functions:

- operation and monitoring of plant equipment
- planning and control of plant evolutions, tests, surveillance, and maintenance
- review of procedures, clearances and work packages
- identification of, and response to, plant safety challenges

Maintenance Personnel

Objective: ensure that fatigue of maintenance personnel does not adversely affect the availability and reliability of equipment that a risk-informed evaluation process has shown to be significant to public health and safety

Functions:

- | | |
|------------------------|---------------------------|
| Surveillance | Post-modification testing |
| Corrective maintenance | Preventative maintenance |

Emergency Response Personnel (Health Physics, Chemistry, and Fire Brigade)

Objective: ensure that fatigue of emergency response personnel does not adversely affect their ability to respond to plant emergencies

Functions include:

- Assessment of in-plant radiological conditions and industrial hazards
- Assessing core status and estimating the source term of a potential release
- Advising the fire brigade leader and control room operators of the effects of the fire and fire suppressants on safe shutdown capability

Work Scheduling Controls

Turnover

Concern - exclusion of turnover from hours counted in work scheduling controls can result in abuse of turnover time as a means of extending work day and worker fatigue

Objective - ensure effective control of turnover time without compromising effectiveness of turnover

Outage Duration

Concern - The consensus position has established a threshold of 72 hours in a 7 day period during outages. Outages can vary substantially in duration. Scheduling personnel for extended periods at or near the threshold can result in excessive cumulative fatigue.

Objective - Ensure effective control of cumulative fatigue during extended outages.

Acceptable Basis for Deviations: Individual is judged FFD and -

Scope of work and responsibilities will not require functions subject to work scheduling controls, or

Necessary to comply with other NRC regulations, or

Necessary to avert a forced plant shutdown, or

Necessary to maintain or enhance immediate capability for responding to challenges to plant safety

Elements of Deviation Authorization

Assessment of Worker FFD

Identification and Evaluation of Options

Risk Management

Assessment of Worker FFD

Worker Fatigue

Work Scope Requirements and Controls

Plant Configuration and Conditions

Worker Fatigue Assessment

sleep-wake history

time of day

duration of variance

job characteristics

environmental factors

Timing of Authorizing Deviations from Work Schedule Thresholds

Deviations to be authorized prior to performing work

FFD assessments of workers to be performed immediately prior to threshold deviations

Safety assessment of scope of work and plant configurations and conditions may be performed in advance if verified immediately prior to performance of work

Authority to Approve Deviations from Thresholds

FFD assessments may be performed by the immediate supervisor of the work to be performed within the scope of the deviation

Authority to approve deviations should be limited to individuals qualified to assess the risk significance of the scope of the work to be performed under the deviation given the plant configuration and conditions

Monitoring Effectiveness of Alertness Management

Data Sources:

Behavioral Observation

Self-Declaration

Root Cause Analysis

Event Frequencies

Work Hours

Deviation Hours

Deviation Approvals

Frequency

Basis

Trends